BY THE COMPTROLLER GENERAL

Report To The Congress

OF THE UNITED STATES

Federal Agencies' Maintenance Of Computer Programs: Expensive And Undermanaged

Federal agencies spend millions of dollars annually on computer software (program) maintenance but little is done to manage it.

GAO studied 15 Federal computer sites in detail, and received completed questionnaires from hundreds of others. All reported large maintenance efforts but few had good records and very few managed software maintenance as a function.

Improvements can and should be made both in reducing maintenance on existing software and in constructing new software to reduce its eventual maintenance costs.

The National Bureau of Standards should issue a standard definition and specific technical guidelines for software maintenance. Heads of Federal agencies should require their automatic data processing managers to manage software maintenance as a discrete function.

AFMD-81-25
FEBRUARY 26, 1981

COMPTROLLER GENERAL'S REPORT
TO THE CONGRESS

FEDERAL AGENCIES' MAINTENANCE OF
COMPUTER PROGRAMS: EXPENSIVE AND
UNDERMANAGED

D I G E S T

Computer software maintenance consumes a large
share of the Federal Government's automatic data
processing (ADP) resources. After computer pro-
grams are put into operation, maintenance may be
needed to make them do more or different tasks,
to remove defects, or to reduce operating costs.
GAO found that software maintenance has not re-
ceived management attention appropriate to its
cost and complexity.

GAO reviewed computer software maintenance in
detail at 15 Federal computer sites and found
their total annual maintenance costs to be
$33 million--$19 million in programmer salaries,
$8 million in other salaries, and $6 million in
computer time. Two-thirds of the programmers at
the 15 sites spent their time on maintenance.
The Director of the General Services Administra-
tion's Software Development Office has estimated
that the Government spends at least $1.3 billion
annually on software maintenance. (See p. 6.)

In spite of the high cost, agencies have a very
limited overview of their software maintenance
operation and have made little concentrated ef-
fort to effectively manage and minimize the re-
sources required to maintain their computer
software.

Maintenance is not managed as a function. That
is, ADP managers have done little either to
identify common causes of maintenance problems
or to take action to reduce maintenance costs.
The absence of maintenance management is due in
part to (a) the absence of a uniform definition
of maintenance, and (b) the absence of Government-
wide guidance on how to control software main-
tenance and reduce its costs.

Managers generally have neither cost accounting
data nor management data on software maintenance
activities and thus know little about how much
maintenance really costs overall, or which types
of maintenance cost the most. Agencies have es-
tablished no goals and standards to measure the

AFMD-81-25

efficiency of their maintenance operation, nor
criteria for acceptable maintenance costs for
given situations. They have made only limited
use of improved tools and techniques which could
reduce maintenance costs.

Software maintenance seems to be a common problem
for all ADP users. The private sector reports
that large percentages of its ADP resources are
consumed by software maintenance.

Increased management attention to several prob-
lem areas could reduce costs. Inadequate em-
phasis in these areas appears to increase the
maintenance workload either by requiring that
extra maintenance be performed, or by detracting
from the efficiency of maintenance that must be
done.

Modifications account for about half of the total
maintenance workload. While some modifications
must be done to adapt software to changing user
needs and prolong its useful life, others occur
only because user needs were not properly iden-
tified in the first production version of the
software. (See p. 17.)

Software is often maintained by people who did
not develop it. If the documentation they need
to understand the software is inadequate or miss-
ing, they must work harder to maintain the
software. Poor documentation can increase the
time to understand and maintain software appli-
cations, or lead to the redesign and rebuilding
of an entire system of programs because under-
standing and modifying an existing program may
be more trouble than building a new one. (See
p. 23.)

Most data processing managers interviewed were
of the opinion that contractor-developed soft-
ware required more maintenance. Numerous ques-
tionnaire respondents indicated that they agreed
with that opinion.

Questionnaire respondents selected better use of
tools and techniques as the second most effective
way to reduce maintenance. GAO has found that
software tools and techniques--despite their

ability to improve the maintenance operation--
are not used to their full potential at many
agency data processing installations. 1/

Some organizations in the private sector have re-
ported maintenance improvements achieved through
better design and quality control in program de-
velopment, increased use of tools and techniques,
better documentation, and personnel-oriented
measures including rotation and cross-training.
(See p. 26.)

GAO developed a Provisional Checklist for Soft-
ware Maintenance Management, shown in appendix I
to this report. The checklist will be useful to
organizations doing software maintenance.

CONCLUSIONS

Software maintenance in the Government is now
largely undefined, unquantified, and underman-
aged. Agencies need to develop and implement
policies and procedures which will increase
maintenance efficiency and ultimately reduce the
amount and cost of software maintenance required.
To help agencies in these efforts, standard def-
initions of the components of software mainte-
nance and guidance on how to reduce its cost are
needed.

RECOMMENDATIONS

GAO recommends that the Secretary of Commerce,
through the National Bureau of Standards, de-
velop and publish:

--Standard definitions of the component parts
  of software maintenance to aid agencies in
  recording and managing it.

--Specific guidance on software maintenance, de-
  tailing both how to improve maintenance of
  existing programs and how to construct new
  programs to reduce their eventual maintenance.
  GAO offers its provisional checklist pending
  action by the National Bureau of Standards.

1/"Wider Use of Better Computer Software Technology Can
   Improve Management Control and Reduce Costs" (FGMSD-80-38,
   Apr. 29, 1980).

GAO further recommends that heads of Federal agencies:

--Begin to manage software maintenance as a discrete function.

--Take measures to identify the amount of resources currently expended on software maintenance.

--Develop maintenance goals and standards as criteria to determine the efficiency and effectiveness of their software maintenance operation.

--Implement management policies and procedures to increase the efficiency of the maintenance operation and reduce future maintenance. (See app. I.)

AGENCY COMMENTS

We asked for comments from the Department of Commerce, the General Services Administration, and the parent agencies of the 15 sites at which we analyzed software maintenance in detail-- listed in appendix IV. The Department of Commerce failed to furnish comments in time for inclusion in the final report. The General Services Administration, the Postal Service, and the National Aeronautics and Space Administration furnished comments in time for inclusion.

The General Services Administration (GSA) agreed with GAO's conclusions and recommendations, agreed with the definition of software maintenance, and said that they plan to assist the National Bureau of Standards in any way possible to provide guidance to Federal agencies concerning software maintenance. GSA clarified its estimate of Federal software maintenance costs by explaining that the costs do not include the software used in embedded weapons system computers.

The Postal Service agreed with GAO's overall recommendations and said that it already has measures underway in keeping with GAO's recommendations to the heads of Federal agencies. The National Aeronautics and Space Administration (NASA) expressed its concern that the definition

does not apply to its software, which is mostly
used in a research and development environment.
In the light of GSA's comments and NASA's con-
cerns, GAO clarified certain details of its
presentation for this final report. The changes
made were not substantive. (See app. V and p. 6.)

The other agencies from whom GAO requested com-
ments failed to respond within the 30-day period
required by Public Law 96-226.

ROUTING AND RECORD SHEET

SUBJECT: (Optional)				DD/A Registry
Software Maintenance				81 0968

FROM:		EXTENSION	NO.
D/ODP/DDA 2-D-00 HQS.	STAT		DATE 5 MAY 1981

TO: (Officer designation, room number, and building)	DATE 5 MAY 1981 RECEIVED	DATE 6 MAY 1981 FORWARDED	OFFICER'S INITIALS	COMMENTS (Number each comment to show from whom to whom. Draw a line across column after each comment.)
EO/DOA				Bill:
1. ADDA, BX--4	5-6		H	Apropos our conversation last week about the impor-
2. D/ODP		5/6		tance of software mainten- ance, and perhaps reinforc-
3. C/MS		5/6		ing my contention that considerations regarding efficient maintenance are
4. C/P4PG		5/12/81		more important than the efficiency of the software, I attach a copy of the
5.				digest of a recent GAO report on Maintenance of
6.				Computer Programs which, they contend, is both ex- pensive and undermanaged in
7.				the Federal government. CIA appears to be ahead of its competition in address-
8.				ing a problem which is clearly of great concern to the Comptroller General.
9.				We do, in fact, cover main- tenance as a separate func- tion and track its costs.
10.				There are several sug- gestions in the report which are worth our atten-
11.				tion, however. I am send- ing a copy to ☐ 25X1 asking whether it contains
12.				suggestions for ways in which we might further improve our management of
13.				this important and costly part of our program.
14.				☐ 25X1
15. E² file				Bruce T. Johnson Att. Thanks Bruce

FORM
1-79 **610** USE PREVIOUS EDITIONS